

Reconstruction of weighted bidirectional networks subjecting to correlated noise*

Emily S.C. Ching¹, Pik-Yin Lai^{2,3}, and H.C. Tam¹

¹Department of Physics, The Chinese University of Hong Kong, Shatin, Hong Kong

²Dept. of Physics and Center for Complex Systems, National Central University, Chungli, Taiwan 320, R.O.C.

³Physics Division, National Center for Theoretical Sciences, Kuang Fu Road 101, Hsinchu, Taiwan 300, R.O.C.

Abstract:

Reconstruction of complex networks from measurements of the individual nodes is a challenge in many branches of science. Here, we study the reconstruction problem for networks of weighted bidirectional diffusive coupling and subjecting to correlated noise of finite correlation time. For such networks that attain a steady state in the absence of noise, we find a theoretical result relating the adjacency matrix of the network to the inverse of the covariance matrix of the measurements. We discuss how to use this theoretical result to reconstruct the links of the network and demonstrate the accuracy of our method using numerical simulated data. When the correlation time of the noise is either much shorter or much longer than the relaxation times of the system, we can further reconstruct the relative weights or the normalized coupling strength of the links. Moreover, our theoretical result explains the shortcomings of the common practices of inferring links using Pearson correlation coefficient and partial correlation coefficient.

*The work of ESCC and HCT has been supported by the Hong Kong Research Grants Council (Grant No. CUHK 14300914) while that of PYL by Ministry of Science and Technology of Taiwan under the grant no. 101-2112-M-008-004-MY3.